REMARKS

The application includes claims 1, 3-7, 9-13, and 40-43. The undersigned notes with appreciation that claims 40 and 41 have been identified as being drawn to allowable subject matter.

With regard to the rejection of claim 42 under 35 U.S.C. 112, second paragraph, the undersigned notes that claim 42 depends from claim 7, not claim 1, and claim 7 does not use the notation "M". Rather, "A" and "B" are two of the constituents noted in claim 7 that are metals, and claim 42 is intended to cover the situation where at least one of those constituents is "Mo". Claim 42 should be allowable for the same reasons as claim 40, and should be in compliance with 35 U.S.C. 112, second paragraph.

Claims 1, 3-7, 9-13, and 43 were rejected as being anticipated by U.S. Patent 4,454,246 to Fung or U.S. Patent 4,359,406 to Fung. Claims 1, 2 and 4 were rejected as being obvious over Journal of Catalysis (XP00909979) in view of either Fung patent. Claims 1, 3-7 and 9-13 have been rejected as being obvious over U.S. Patent 4,367,137 to Antos. Each of these rejections is traversed.

1) The Declaration of Dr. Oyama and the Fung and Antos References

To clarify one misunderstanding about the evidence submitted by declaration of Dr. Oyama under 37 C.F.R. 1.132, and the articles to Goodenough "Transition Metal Compounds" *Journal of Applied Physics* 40:1250-1257 (1969) and Wang, "Synthesis, Characterization, and Hydrotreating Activity of Several Iron Group Transition Metal Phosphides" *Journal of Catalysis* 208:321-323 (2002) (which were both referenced by Dr. Oyama in the declaration), the undersigned notes the following:

1) Goodenough does **not** indicate that metal phosphides will not be produced below 850°C, as is stated by the Examiner on page 6 of the application. Rather, Goodenough discusses the **use** of 850°C temperature exposure in forming certain metal phosphides (page 1251), but does not state that 850°C is required.

2)Wang is co-authored by the Applicant. Wang demonstrates in Figure 4 (page 325) the **formation** of a specific metal phosphide, Co/P, from reduction of cobalt phosphates. As can be seen from the Figure, phosphide formation from cobalt phosphates does not begin until about 550°C-560°C (see the first peak), and completion is not achieved until about 690°C (see second peak). Example 5 on page 16 of the patent application corresponds to the data in Wang. It does **not** conflict with the data.

Fung Patents

Dr. Oyama's declaration establishes scientifically that **non-noble** metal phosphides cannot be formed by the process of Fung. It does **not** dispute or take issue with the formation of PtP_2 by the direct reduction procedures in Fung. Note particularly pages 4 and 5 of Dr. Oyama's declaration where it is demonstrated that if you do not first calcine the metal precursors at high temperature to form a phosphate, and then perform reduction on the phosphate (as is disclosed in the present application), metal phosphide catalysts will not be produced (Fung describes direct reduction without prior phosphate formation—this works for Pt phosphides, but not the non-noble metal phosphides contemplated by this invention and which are specifically set forth in independent claims 1 and 7).

As is demonstrated in the table on page 5 of Dr. Oyama's declaration, if Fe, Co, and Ni metal precursors are subject to reduction without prior phosphate formation, and under the same temperature conditions as described in the Fung patents a metal, **not a metal phosphide,** is produced. However, when the same metal precursors are calcined to form a phosphate, where the positive metal ion is combined with the negative phosphate species, and then reduced under higher temperatures, **a metal phosphide is produced, not a metal**. As such, the data presented in the declaration of Dr. Oyama, clearly and unequivocally, establishes that the direct reduction of components, as is contemplated in the Fung references, does **not** work for the base metals recited in the claims of the present application. Dr. Oyama's declaration does not attack or dispute Fung's methodology and

results with platinum. Rather, it establishes that for non-noble metals, you must first combine the metal and phosphorous in order to make a metal phosphide. Further, as the Examiner will acknowledge, Fung presents no evidence whatsoever of the formation of any other metal phosphides other than platinum phosphides. Rather, Fung only references that the possibility of forming other phosphides such as iron, cobalt, and nickel. However, Dr. Oyama's data clearly establish that these phosphides cannot be made by the processes contemplated by Fung. Further, the Examiner should note that claim 1 of U.S. patent 4,454,246 to Fung is limited to a **noble** metal phosphide, most likely because that is all Fung provides an enabling disclosure for.

Finally, the Examiner's reference to the possible use of higher temperatures being contemplated in Fung (e.g., 650°C) is not on point. It should be understood by the Examiner that once reduction of the precursor to a **metal** has occurred, as is demonstrated in the table on page 5 of the declaration, there is **no chance** that a metal phosphide will then be formed from the metal (i.e., the metal precursor has already been reduced to a metal). Hence higher temperatures would have absolutely no effect on the already reduced metal compound. What is important, and is established unequivocally by the declaration is that you must first combine the non-noble metal and the phosphorous, such as by forming a metal phosphate by high temperature calcining. Once the metal and the phosphorous are combined, reduction will result in the formation of metal phosphides of non-noble metals (see the table on page 5 of Dr. Oyama's declaration as well as all of the test results in the Examples section of the present application at pages 12-21).

Antos

As demonstrated above, the references cited in Dr. Oyama's own declaration do not call into question the results presented in the table on page 5, as the Examiner has suggested. Rather, they corroborate the results. In fact, the results in Wang correspond directly to the results in Example 5 of the application.

As noted by Dr. Oyama on page 6 of the declaration, Antos never indicates or suggests formation of a phosphide. Rather, column 14 of Antos makes it clear that it is unclear what the nature of the materials of that are formed via his processes.

Dr. Oyama's declaration establishes at page 6 that the temperatures employed by Antos are too low to cause the formation of a cobalt phosphate. Furthermore, Dr. Oyama's declaration is directly corroborated by Figure 4 on page 325 of the Wang reference supplied with Dr. Oyama's declaration.

The Declaration of Dr. Oyama and the Nozaki Reference (Journal of Catalysis XP009009979)

To clarify another misunderstanding, the declaration of Dr. Oyama establishes that with respect to the non-noble metal phosphide catalysts he is claiming the choice of support matters, and that alumina is a very poor choice of support for phosphides. Figures 1 and 2 of the declaration show the reduction profiles of MoP on silica and on alumina. It is demonstrated that when alumina is used as the support temperatures of more that 300°C higher are required because of the formation of aluminum phosphate as the result of the strong interaction between Al and P. Figure 3 of the declaration presents a comparison for the synthesis of nickel phosphide on various supports. Again, more than a 300°C difference in temperature is required for reduction when alumina is used as a support as opposed to KUSY or MCM-41. Figure 4 shows the formation of molybdenum, tungsten and nickel phosphides on a carbon support can be achieved using low temperatures.

As the Examiner will recognize, alumina is not a recited support in claims 1 or 7.

Conclusions

All claims are in *prima facie* condition for allowance. As noted above,

neither of the Fung patents disclose evidence of metal phosphides other than platinum phosphides (composition claims in '246 to Fung are limited to noble metal phosphides), and the declaration of Dr. Oyama establishes that non-noble metal phosphides cannot be formed by the direct reduction methodology taught by Fung. Thus, claims 1, 3-7, 9-13 and 43 are not anticipated by either Fung reference. Furthermore, claims 1, 2 and 4 cannot be obvious over a combination of Fung and Nozaki for the same reasons (i.e., Fung does not demonstrate the claimed non-noble metal phosphide catalyst), and the additional reason that Nozaki is focused on alumina, and Dr. Oyama's declaration demonstrate new and unobvious problems when alumina is used as a support (and claims 1, 2 and 4 do not recite alumina). Finally, claims 1, 3-7, and 9-13 are not obvious over Antos because Antos does not describe formation of a metal phosphide, and Dr. Oyama's declaration with corroborating supporting data in Wang show that the temperatures used in Antos would not result in formation of a metal phosphide.

Respectfully submitted,

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